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THE MESILLA PARK FIBER SORTER, AN INSTRUMENT FOR SORTING SHORT FIBERS AND LONG FIBERS IN COTTON LINT

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ABSTRACT

The Southwestern Cotton Ginning Research Laboratory, Mesilla Park, N. Mex., developed an instrument and a method for determining short-fiber and long-fiber content in ginned lint. The method with the Mesilla Park fiber sorter is four to five times faster than the method with the Suter-Webb Sorter.[2/] Short-fiber results from the two instruments correlated highly, and long-fiber percentages from the Mesilla Park fiber sorter and mean-length results from the Suter-Webb Sorter correlated highly. With the two sorters, the relationships between short fibers and spinning properties were similar. The spinning properties included picker and card waste, ends down, yarn imperfections, yarn appearance, and break factor.

INTRODUCTION

Research results in numerous publications have shown that the presence of varying amounts of short fibers in ginned lint can be caused by environmental conditions, including ginning practices, and that excessive amounts of short fibers are detrimental to spinning performances (2, 3, 4, 5).[3/] The measurement of short fibers in ginned lint, usually expressed as the percentage by weight of fibers one-half inch and shorter, is derived from the tedious and expensive Suter-Webb Sorter array of fibers of all lengths in a sample (1, 7). The expense and time involved do not allow sufficient use of this short-fiber measurement even in research activities that rely heavily upon laboratory measurements for fiber quality evaluations (8).

Southwestern Cotton Ginning Research Laboratory personnel developed an instrument and a test procedure for rapidly determining the short-fiber content and the long-fiber content in ginned lint. The instrument is called the Mesilla Park fiber sorter.

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2/ Trade names are used in this publication solely for the purpose of providing specific information. Mention of a trade name does not constitute a guarantee or warranty of the product by the U.S. Department of Agriculture or an endorsement by the Department over other products not mentioned.

3/ Numbers in parentheses refer to Literature Cited, page 13.

The Development of the Mesilla Park Fiber Sorter

As early as 1956, one objective in the ginning and fiber quality research program at Mesilla Park, N. Mex., was to develop an instrument and test procedure to measure rapidly short fibers and long fibers in ginned lint. With speed and precision the prime considerations, initial steps were taken to make use of the rapidly prepared beard of fibers on the fibrograph comb. The beard of fibers extending through the fibrograph combs comprise over half the fibers used in the hand-combing process, and less than half remain tangled back of the combs. The tangled mat prohibits fiber extraction from the fibrograph combs without excessive breakage. The general idea was to separate the combed beard from the entanglement behind the combs so that fibers of short and long groups could be extracted as is done with the Suter-Webb Sorter. However, the Suter-Webb Sorter separates all length groups in great detail. Attempts were made to cut or shear the fibers along the toothprints of the fibrograph beard with household scissors, barber scissors, razor blades, and a paper trimmer. The shearing action of the paper trimmer proved to be superior to the other methods.

A temporary device to hold the sheared beard in place for fiber extraction consisted of two upright, paralleled, fine combs so the sheared end would rest along one comb, and the bulk of the beard would extend through the second comb. Each fine comb was approximately 6 inches long and 5/16 inch deep, with 66 teeth per inch, and the two combs were 7/32 inch apart. In this crude arrangement, the long fibers were extracted with a forceps, and the short fibers were removed from the space between the two upright fine combs.

In 1960, a slotted holder to hold a modified fibrograph comb was mounted on the side of the handle of the paper trimmer in such a manner that the fiber loaded fibrograph comb led the shearing blade attached to the handle. When the fibrograph comb passed in close proximity to the edge of the base-mounted stationary metal part of the shearing device, the fibers or beard were automatically and instantly stripped from the comb and were placed in proper position on the base of the trimmer for shearing. On the same downward stroke of the handle, the shearing edge of the handle-mounted blade following the fibrograph comb sheared the stripped specimen along the dotted line or fibrograph comb toothprints of the beard. For greater speed in extracting fibers by length groups from the beard, a 7-inch-wide forceps with leather pads was made.

In 1961, experiments were conducted with various designs and materials in making a fiber depressor to hold the fibers in the upright combs of the instrument. A slotted and hinged depressor was found satisfactory. Short-fiber percentages, based on the original weight of the specimen, correlated with Suter-Webb short fiber percentages at +0.74. This correlation, however, was slightly improved to +0.77 when the percentage of fibers combed through the fibrograph combs was considered. With the longer and finer cottons, larger percentages were combed through the hand-operated fibrograph combs than with shorter and coarser cottons.

In 1961 published data (6) provided material for calculating correlations between Suter-Webb short fibers and numerous fiber and spinning properties. All correlations were statistically significant and indicated the importance of short fibers. Other studies with various cottons and the experimental Mesilla Park fiber sorter indicated positive relationships between short fibers and the strength of attachment of fibers to seeds, immature fibers, and cottonseed linters contents.

In 1963, the 7-inch forceps was equipped with two locking devices to improve the grasping of the fibers. Mechanically blended fibers with the USDA-developed blender were compared with a hand method. For both methods, 16 tiny pinches were taken randomly from the laboratory sample. There was no apparent difference in the results, and the hand method was much faster.

In 1964 and 1965, various fiber samples were used to compare results from the new Mesilla Park fiber sorter and the established Suter-Webb Sorter. In 1966, new samples were obtained and different objectives were established. The U.S. Department of Agriculture Cotton Pilot Spinning Laboratory at Clemson, S. C., furnished ginned lint samples with corresponding fiber and spinning quality measurements. The objectives were (1) to compare the relationship between Suter-Webb Sorter short fibers and Mesilla Park sorter fibers, and (2) to compare the relationship between Suter-Webb short fibers versus spinning quality measurements with Mesilla Park short fibers versus spinning quality measurements.

The Mesilla Park Fiber Sorter and Its Test Procedure

Following the gradual development of the instrument and testing procedure as related above, the instrument now appears as in figure 1. It is composed of an 11-inch paper trimmer with part of the base removed, mounted Suter combs in parallel to each other and to the shearing edge, modified fibrograph combs for specimen preparation, and a 7-inch-wide clamp with leather pads for extracting fibers. The operation sorts the fibers into three length groups--long, intermediate, and short.

Fibers are randomly selected from a perconditioned laboratory sample (65 percent relation humidity, 70° F.) in an approved manner (ASTM)(1) weighed, and are hand-combed on fibrograph combs that have been modified with rails(A) (letters in parentheses refer to figure 1) so the comb can fit into the slotted comb holder (B). The slotted comb holder is attached to the moving blade of the paper trimmer (C). After a fiber-loaded fibrograph comb is placed into the slot, the paper trimmer handle (C) is pulled downward; the holder (B) is followed by the depressor (D), which in turn leads the shearing edge of the handle (C). The fibrograph comb (A) is removed from the slotted holder (B). The handle (C) is raised, which automatically raises the slotted holder (B); then the slotted depressor (D) is raised, as is shown in figure 1. The fiber clamp or forceps (I)--7 inches wide, leather-padded, and equipped with double locking devices--is used to extract fibers. The long fibers, in the "free" end area, are extracted with the forceps with a few "bites" up to the first or dropping comb (G). After this comb is dropped, the forceps is used to extract the intermediate length fibers between the two upright fine combs (F, G). The remaining short fibers between the stationary upright comb (F)

and the stationary edge of the shearing device (E) are stripped off by hand. The groups of fibers--long, intermediate, and short--are saved and weighed with corresponding groups extracted from the second fibrograph comb.

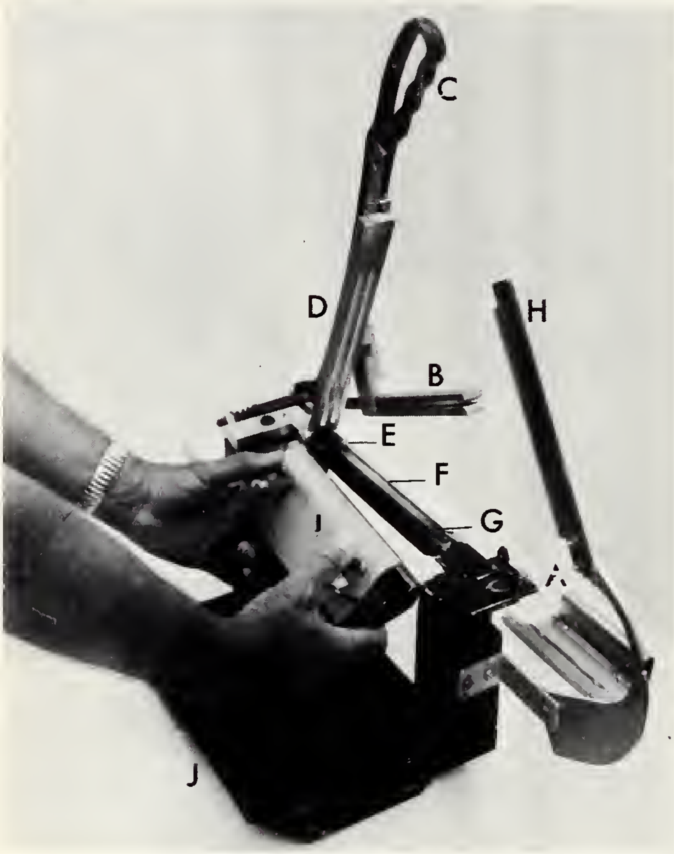

Figure 1. Mesilla Park fiber sorter: (A) Fibrograph comb; (B) slotted holder for fibrograph comb; (C) handle of hinged shearing device; (D) slotted hinged fiber depressor; (E) stationary shearing edge; (F) "second" or stationary comb; (G) "First" or dropping comb; (H) "third" comb; (I) 7-inch double locking forceps; and (J) base of instrument.

The distance to the first comb from the zero or baseline is eleven-sixteenths of an inch. The distance to the second comb from the baseline is eleven-thirty seconds of an inch, or one-half the former distance. The first comb, farther from the baseline, is so called because the first operation of extracting fibers is in this area.

The weight of the short fibers from the two fibrograph combs (one pair) is divided by the total weight of the fibers combed; the weight of the tangled fibers behind the fibrograph combs is excluded. Likewise, the weight of the long fibers from the pair of fibrograph combs is divided by the total weight combed. This method of calculation provided more useful results than when the total original weight of the specimen (0.1 gram) was used as the divisor. Cottons with fine fibers, or relatively low micronaire fibers, have a larger proportion of the fibers to comb through the fibrograph combs. The recommended method of calculation apparently takes into account the effects of differences in fineness and coarseness of fibers.

Comparing Results of the Two Sorters

Results of the measurements of short fibers and long fibers in ginned lint samples from the Mesilla Park fiber sorter were compared with those from the Suter-Webb Sorter. The cottons included California and Arizona growths of upland and a New Mexico growth of Pima. All cottons, from gin cleaning or gin drying studies or both, were tested for spinning performance, with and without the crusher roll, and for fiber qualities including Suter-Webb arrays.

The Pima cotton, subjected to ginning treatments more gentle and quite different from those used for the uplands, showed less response to the treatments than did the uplands. All measurements of the Pima short fibers with both instruments were low and in a small range. However, the correlation for Pima short fibers with the two instruments was +0.79 and was significant at the 1.0 percent level of confidence. The correlation between the Mesilla Park sorter long fibers, a percentage, and the Suter-Webb Sorter mean length in inches was +0.63, significant at the 1.0 percent level.

Both of the upland cottons had significant correlations at the 1.0 percent level between the two instruments for short-fiber measurements and for long-fiber measurements. The California upland short fiber measurements correlated at +0.93; long fibers at +0.88 (fig. 2). The Arizona upland short-fiber measurements correlated at +0.89; the long fibers, at +0.92. Therefore, the relationships between the two instruments for short fibers and long fibers were similar for the two upland cottons. With all varieties and both instruments, the short fiber contents increased as the ginning treatments increased drying temperatures and amounts of cleaning machinery.

Based on measurements of short fibers in the California cottons with the two sorters, Suter-Webb short fibers in such cottons can be predicted from Mesilla Park short fiber determinations with the formula: $Y = -6.727 + 0.841 X$, when Y = Suter Webb and X = Mesilla Park. For all cottons tested, including California and Arizona uplands and Pima, the formula is $Y = -4.40 + 0.697 X$.

Measurements showed that the Mesilla Park Fiber sorter was four to five times faster than the Suter-Webb Sorter

Comparing Relationships of Short Fiber Measurements in Ginned Lint with Spinning Properties Using the Two Fiber Sorters

With both instruments, relationships between short fibers and spinning properties were similar for both upland cottons tested and for both methods of spinning, with and without the crusher roll. In figures 2-7 the results are shown graphically for only the California upland cotton, and beyond the position of the crusher roll in the Cotton Pilot Spinning Laboratory, the results are shown only for the yarns spun from the cotton that did go through the crusher roll.

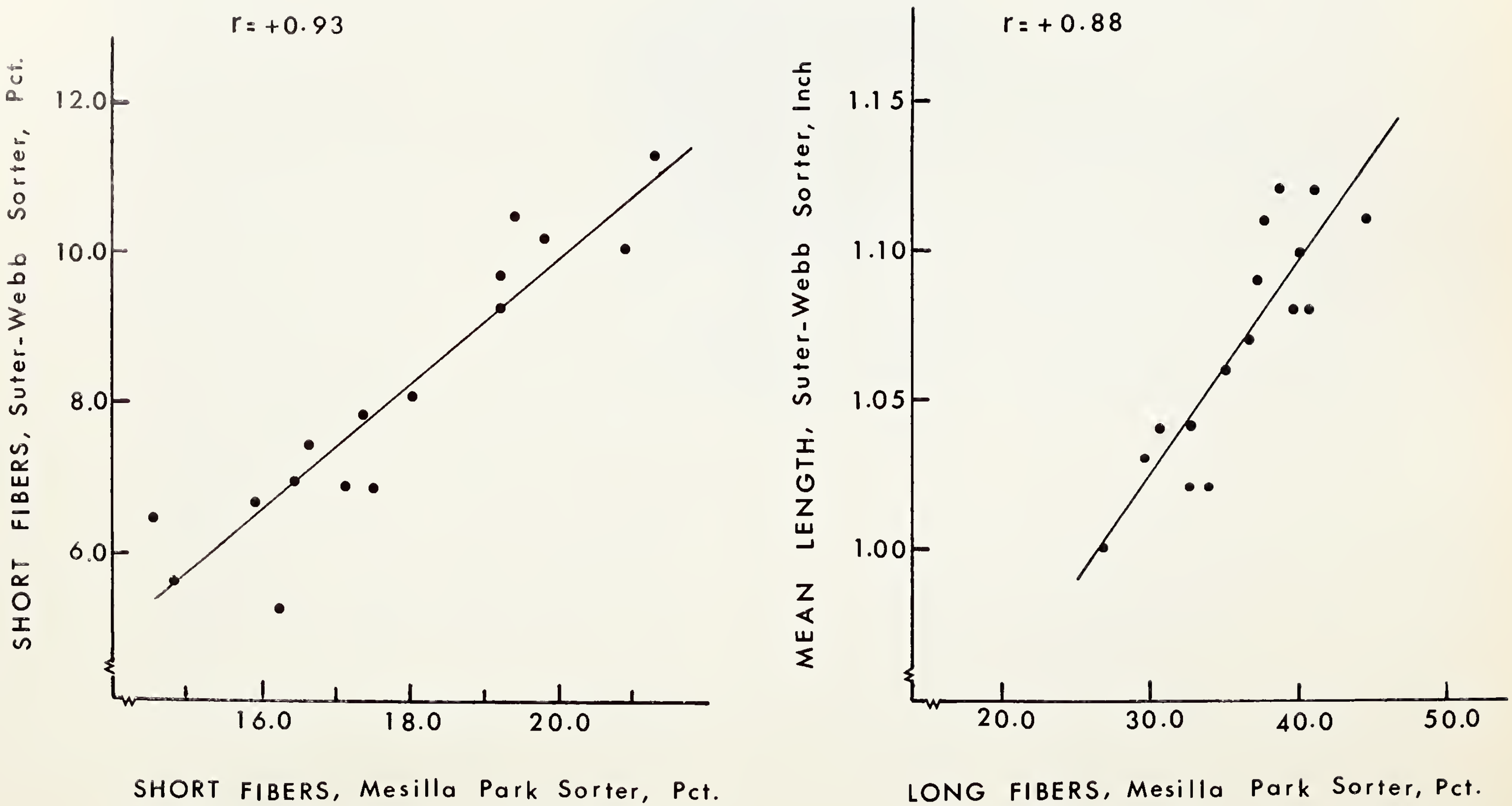

Figure 2. Relationships between short-fiber measurements with the Mesilla Park fiber sorter and the Suter-Webb Sorter, and between long-fiber measurements with the two instruments.

The total picker and card waste percentages versus Suter-Webb short fibers and Mesilla Park short fibers gave correlations of -0.85 and -0.82, respectively (fig. 3).

The ends down per thousand spindle hours versus Suter-Webb short fibers and Mesilla Park short fibers gave correlations of +0.76 and +0.74, respectively (fig. 4).

The total yarn imperfections, including neps, thick places, and low places per thousand yards, versus Suter-Webb short fibers and Mesilla Park short fibers gave correlations of +0.92 and +0.91, respectively (fig. 5).

The yarn appearance indexes versus Suter-Webb short fibers and Mesilla Park short fibers gave correlations of -0.72 and -0.74, respectively (fig. 6).

The break factor versus Suter-Webb short fibers and Mesilla Park short fibers gave correlations of -0.81 and -0.88, respectively (fig. 7). All correlations shown were significant at the 1.0 percent confidence level.

SUMMARY

The short-fiber measurements with the Mesilla Park fiber sorter compared favorably with the short-fiber measurements with the Suter-Webb Sorter, in relation to each other and in relation to various spinning properties and yarn qualities as affected by ginning treatments. The method with the Mesilla Park fiber sorter is four to five times faster than the method with the Suter-Webb Sorter.

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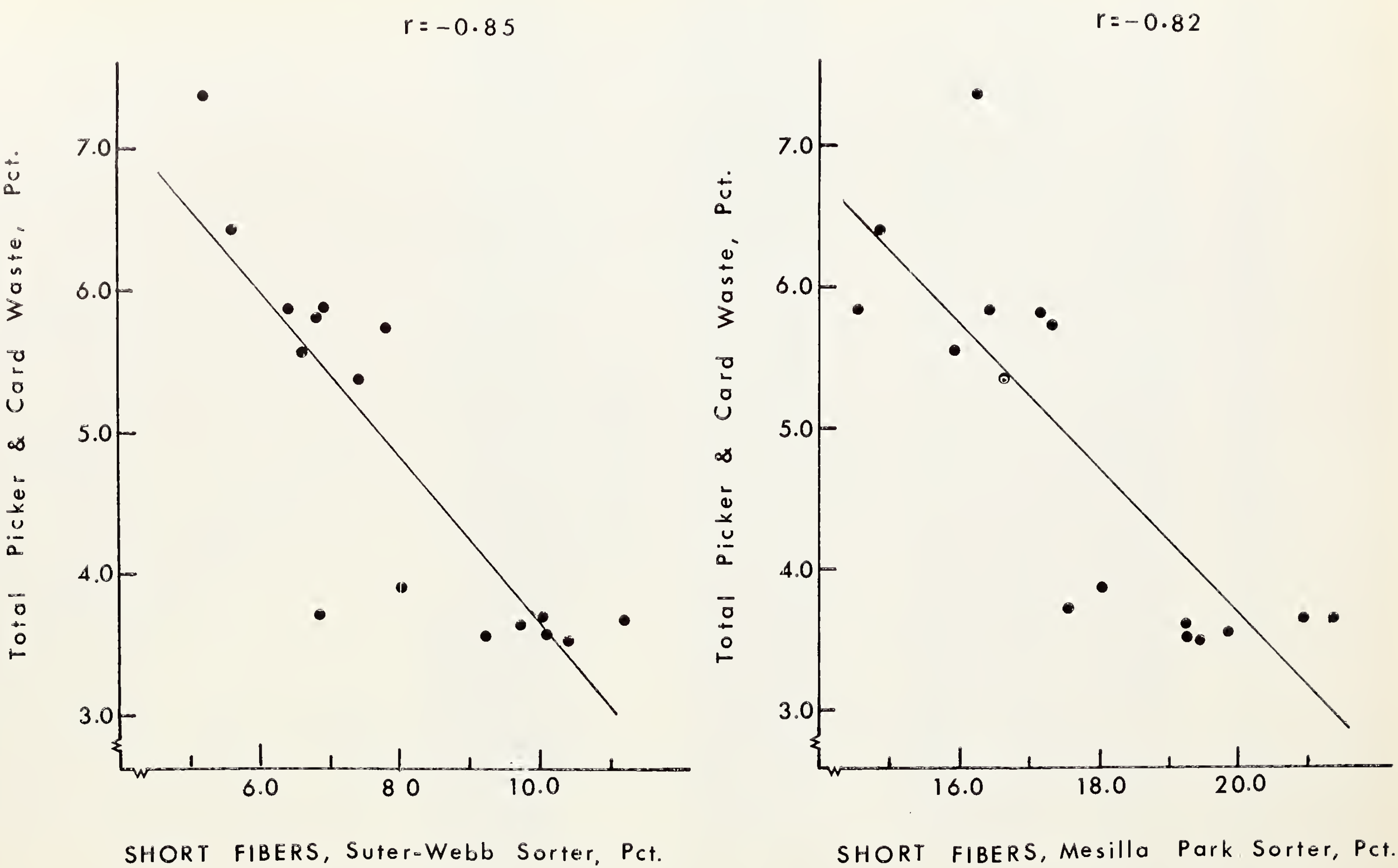

Figure 3. Relationships between total picker and card waste and measurements of short fibers in ginned lint with two instruments.

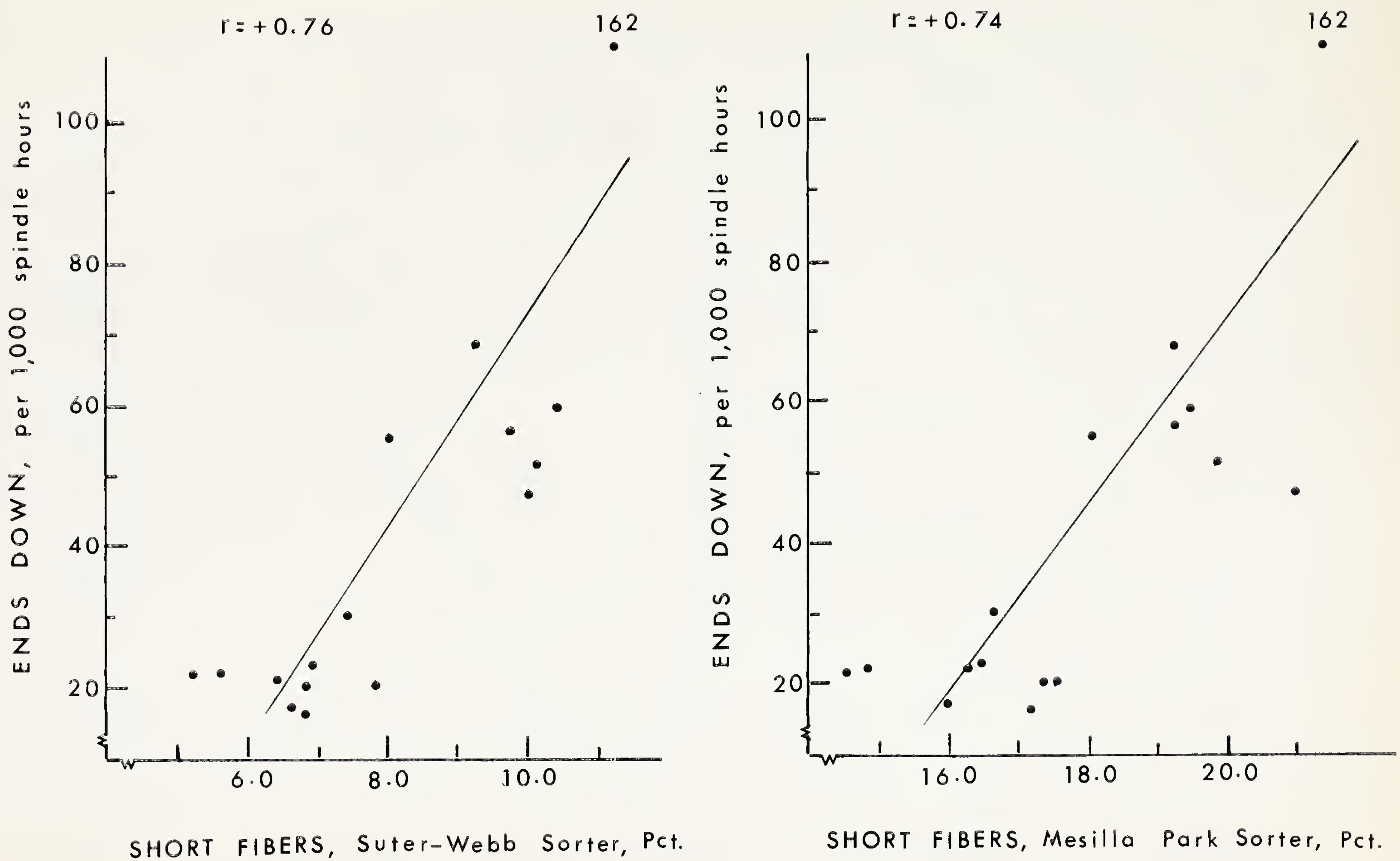

Figure 4. Relationships between ends down and short fibers measured with two instruments.

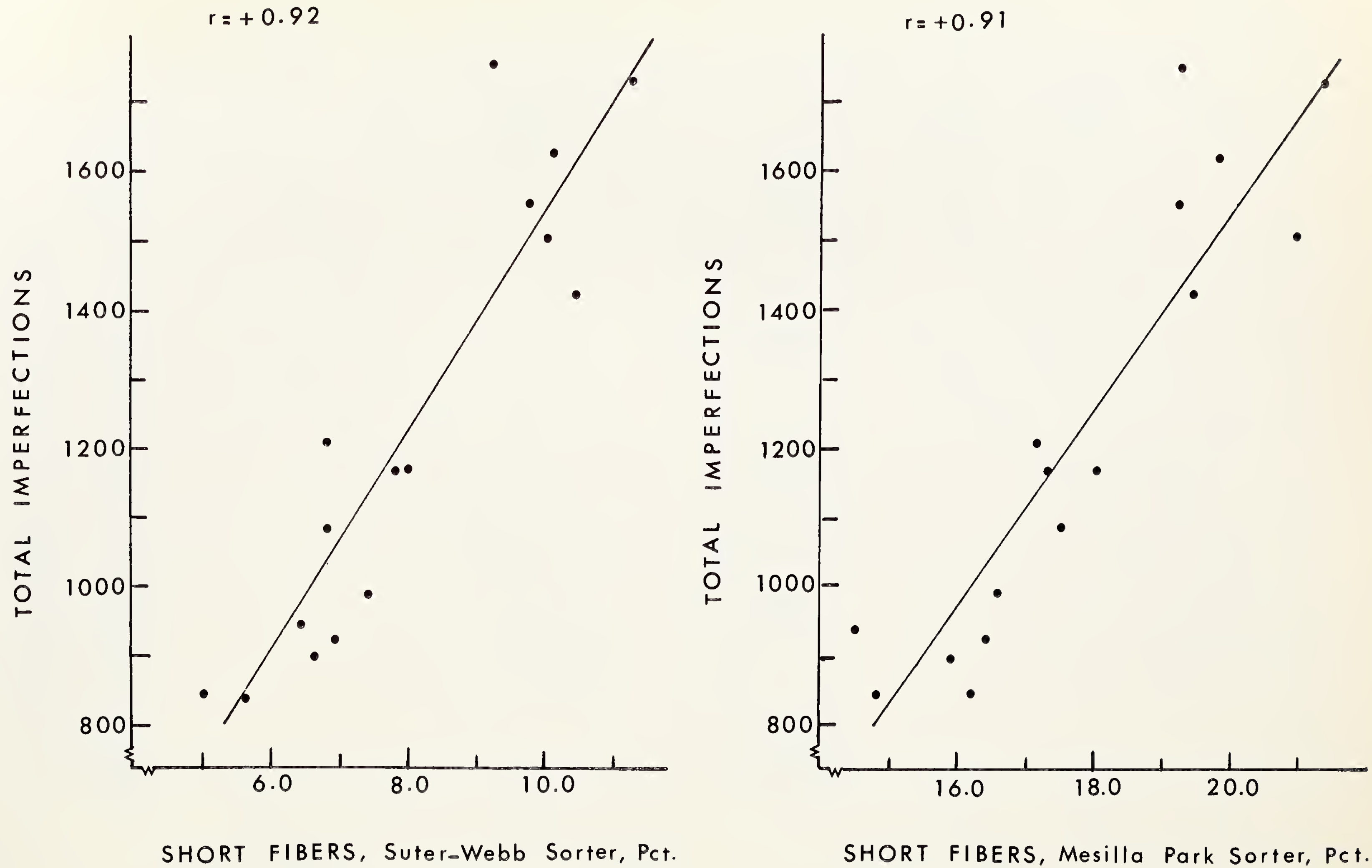

Figure 5. Relationships between total yarn imperfections and short fibers measured with two instruments.

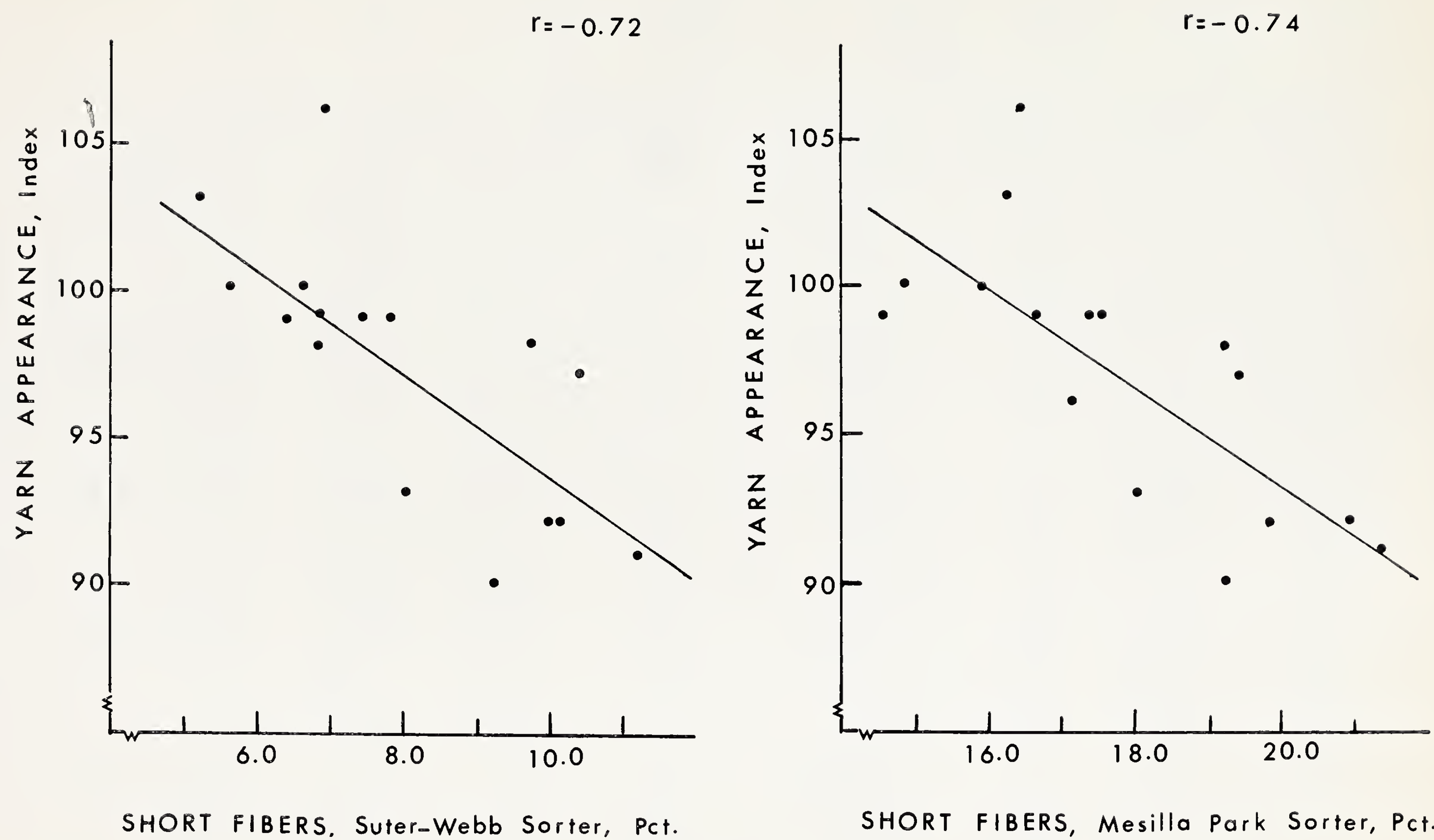

Figure 6. Relationships between yarn appearance and short fibers measured with two instruments.

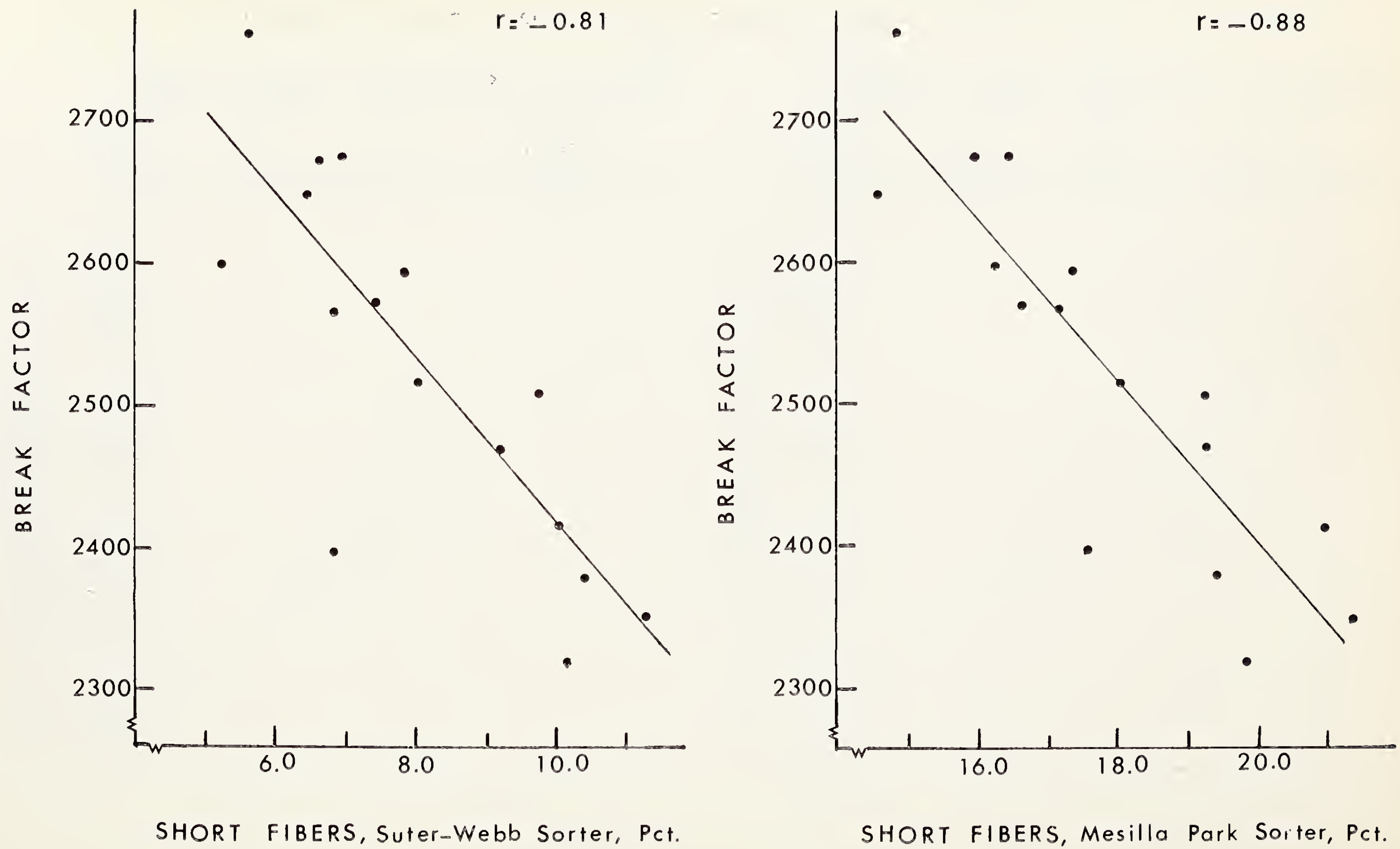

Figure 7. Relationships between break factor and short fibers measured with two instruments.

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